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Xerula setulosa, a new Neotropical agaric record for Argentina

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Abstract—A collection of *Xerula setulosa* is recorded for the first time from Argentina. This species was previously reported from Central America and Brazil. A complete description of the specimens, photographs in the natural habitat, and illustrations of diagnostic microscopic characters are presented. Comments regarding the distribution and related species are provided.

Key words—*Agaricales,* fungi, mushroom, *Physalacriaceae*, taxonomy

Introduction

Maire (1933) proposed *Xerula* to accommodate *Agaricus longipes* Bull. [= *Xerula pudens* (Pers.) Singer]. The genus has undergone many successive taxonomic reclassifications including genus, subgenus, and section, but always associated in some way with the genera *Oudemansiella* Speg. and *Mucidula* Pat. (Moser 1955; Singer 1962a,b, 1964, 1986; Clémençon 1979; Dörfelt 1979; Pegler & Young 1987; Halling & Mueller 1999; Petersen 2008; Yang & al. 2009). Morphological and molecular phylogenetic analyses now support *Xerula* as an independent genus within *Physalacriaceae* (Binder & al. 2006, Petersen & Hughes 2010).

Xerula is characterized by its collybioid basidiomata with dark colors (gray, brown to black); white distant and broad lamellae; rooting stipe, with velutinous, strigose or hispid surface and presence of caulosetae; white spore-print; and hyaline, broadly ellipsoid to globose spores (Wang & al. 2008). *Xerula* is related with *Paraxerula* R.H. Petersen, *Protoxerula* R.H. Petersen, and *Hymenopellis* R.H. Petersen, differing from these in the thick-walled, stiff, brittle, blond to rufous brown pileocystidia (Petersen & Hughes 2010).

There are no previous Argentinean records of species currently accepted in *Xerula*. *Xerula radicata* (Relhan) Dörfelt, which was recorded from Argentina (Niveiro & Albertó 2012; Raithelhuber 1974, 1987, 1991, 1995; Singer 1964; Singer & Digilio 1952), is currently accepted as *Hymenopellis radicata* (Relhan) R.H. Petersen (Petersen & Hughes 2010). The aim of this work is to describe the first Argentinean *Xerula* collection.

Materials & methods

The material, which was collected in the province of Salta, Argentina, was photographed and described macroscopically in situ. The specimens were identified through morphological examination following Largent (1986), Vellinga (1988), and Lodge & al. (2004). Color terminology is according to Kornerup & Wanscher (1978). Specimens were sectioned by freehand and mounted in 5% KOH (v/w) with 1% phloxine aqueous solution for microscopical examination. Melzer's reagent (Wright & Albertó 2002) was used to verify amyloid reaction. Microscopic structures were measured directly with 1000× immersion objective or through photographs taken with a Leica EC3 built-in camera using Image Pro Plus® 4.0 software. The minimum-maximum intervals were provided for the different microscopic structures. For basidiospores, n = number of spores measured, x = mean values, Q = length/diameter coefficient, and Qx = mean value of Q. Authors of scientific names follow Index Fungorum (2019), and herbarium acronyms follow Thiers (2019). The collection was dried, kept in the freezer for a week, and deposited as reference in the CTES herbarium.

Taxonomy

Xerula setulosa (Murrill) R.H. Petersen & T.J. Baroni,
Mycotaxon 101: 114. 2007. Figs 1, 2

≡ *Gymnopus setulosus* Murrill, N. Amer. Fl. 9: 373. 1916.
= *Lentinus pilosus* Rick, Lilloa 2: 310. 1938, nom. illegit. [non (Fr.) Fr. 1838].
≡ *Xerula pilosa* Singer, Lilloa 26: 86. 1954.
≡ *Oudemansiella pilosa* (Singer) Singer, Sydowia 15: 59. 1962.

Basidiomata collybioid, solitary, radicating, growing on humus. Pileus ≤35 mm diam., convex to depressed plane, with a truncate to mammilate umbo, surface dry, roughened, sometimes delicately arched, on the disc light brown (5D5), pale yellow (4A3) and greyish yellow (4C4), or yellowish

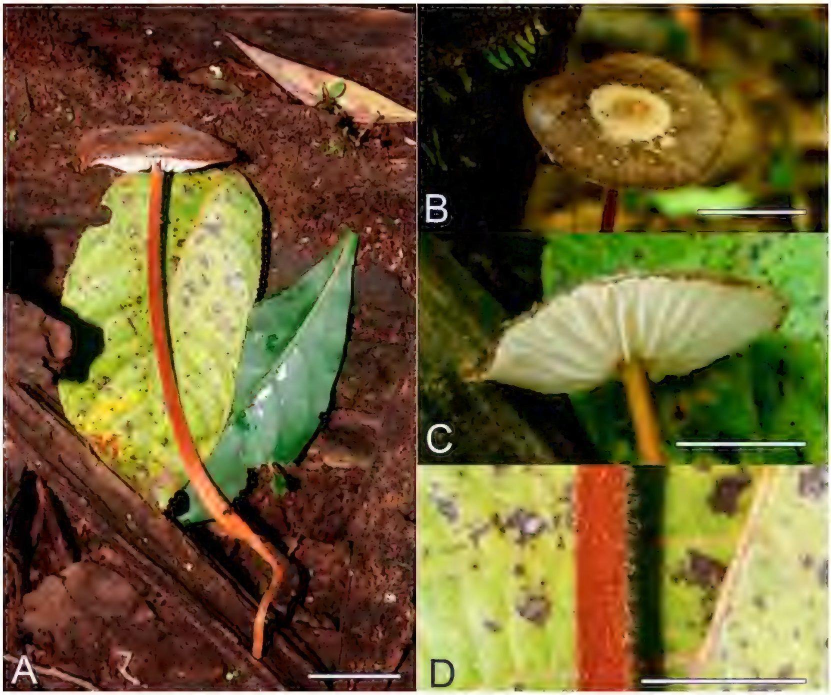

Fig. 1. *Xerula setulosa* (CTES – Niveiro & al. 2198) A. General aspect of basidiomata; B. Detail of pileus; C. Detail of lamellae; D. Detail of stipe pubescence. Scale bars = 20 mm. Photographs by N. Niveiro.

brown (5D6), towards the margin olive brown (5E5) to dark brown (6F5), strongly pubescent with brown hairs, margin somewhat incurved, undulated, not striate. Context fleshy but very thin, <1 mm, white, unchanging when cut. Smell and taste not checked. Lamellae distant to subdistant, white (1A1), adnexed to adnate, ventricose, margin entire, lamellulae two-tiered. Stipe central, 150 × 4–8 mm, compressed, attenuated base and apex, hollow, grayish orange (6B6) to brownish orange (7C8), strongly pubescent, hairs ≤1 mm, greyish-yellow (4B4) to golden (4C6); leathery pseudorhiza attenuating quickly, stipe concolorous with the stipe, pubescent. Annulus and other velar structures absent. Spore-print white (1A1).

Basidiospores 10–13.8 × 10–12.5 µm; x = 12.2 × 11 µm; Q = 0.97–1.3; Qx =1.1; n = 25; globose to subglobose, thin-walled, smooth, chestnut, lacking evident germ pore, with a prominent apiculus. Basidia 30–60

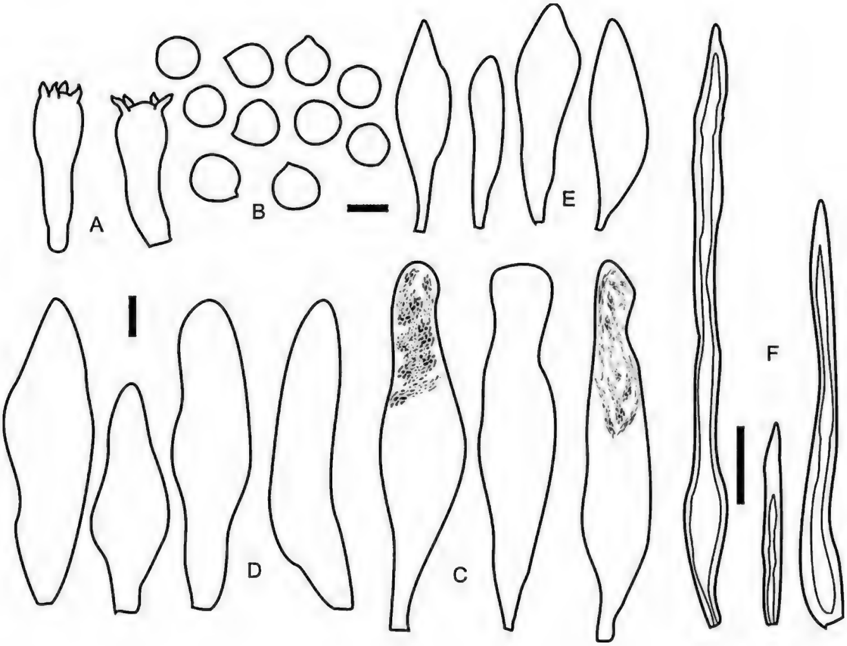

Fig. 2. *Xerula setulosa* (CTES – Niveiro & al. 2198)*:* A. Basidia; B. Spores; C. Cheilocystidia; D. Pleurocystidia; E. Pileipellis elements; F. Pileipellis pileosetae. Scale bars: A–D = 10 µm, F = 40 µm.

× 10–17 µm, claviform to ventricose, 4-spored, thin-walled, hyaline. Pleurocystidia60–130 × 12–35 µm, broadly lageniform, with a truncate apex, thin to thick-walled mainly at the base. Cheilocystidia 50–80 × 10–24 µm, fusiform to utriform, thin-walled to thickened at the base, hyaline. Hymenophoral trama bilateral with a thin half-layer and divergent gelatinous hyphae. Pileipellis hymeniform, composed of two types of elements: 1) Pileocystidia fusiform, 45–60 × 15–18 µm, thick-walled, pigmented with olive content; 2) Pileosetae ≤700 µm long, 10–17 µm diam., dark brown with sharp ends and thickened (≤4 µm) walls. Stipe surface composed of two elements, similar to the pileocystidia and pileosetae. Clamp connections absent.

Specimen examined—**ARGENTINA. Salta Province. Santa Victoria Dept.,** Baritú National Park, road to Baritú town, 22°26′41″S 64°44′37″W, 1421 m a.s.l., 22.III.2011, leg. Niveiro & al. 2198 (CTES).

Discussion

Xerula setulosa is characterized by its strongly pubescent basidioma, yellowish brown to dark brown pileus surface, orange brown stipe, pure white lamellae, globose smooth spores, and numerous cystidia (Wang & al. 2008). It was originally described from Brazil by Rick (1938) under the illegitimate name *Lentinus pilosus* [≡ *Xerula pilosa* (Singer 1954); ≡ *Oudemansiella pilosa* (Singer 1962b)]; however, Petersen & Baroni (2007) synonymized these names under *Xerula setulosa*.

The only *Xerula* species previously reported from Argentina (as *X. radicata*) is currently named as *Hymenopellis radicata*, which differs morphologically from *X. setulosa* by the absence of pubescence (Putzke & Pereira 1988, Raithelhuber 1995).

Six species are currently accepted in *Xerula*: *X. hispida* Halling & G.M. Muell., *X. melanotricha* Dörfelt, *X. pudens, X. setulosa, X. sinopudens* R.H. Petersen & Nagas., and *X. strigosa* Zhu L. Yang & al. They can be distinguished by basidiome color, basidiospore morphology, setae, and other microscopic characters (Wang & al. 2008, Petersen & Hughes 2010). Distribution is also significant in that species are generally limited to certain geographical areas; so far, species reported from Europe and Asia are not found in the Americas.

Xerula setulosa seems closely related to *X. hispida* because of its strongly pubescent basidioma and the presence of a pseudorhiza (Petersen & Baroni 2007, Rodríguez-Alcántar & Herrera-Fonseca 2016). However, *X. hispida* is distinguished by microscopic characters, such as bisporic basidia and the presence of clamp connections. Petersen & Baroni (2007) hypothesized that *X. hispida* might represent an asexual state of *X. setulosa*, but unpublished molecular studies by Wang & al. (2008) placed the two species in different clades. On the other hand, Halling & Mueller (1999) reported absence of clamp connections in *X. hispida*. Both species have a similar distribution in Mexico, Central America, and South America.

Xerula melanotricha is clearly separated by its distribution (Europe, western Asia and northern Africa) and the presence of its very long, almost black setae ≤3 mm that are usually visible to the naked eye. However, in some younger *X. melanotricha* specimens possess hairs that barely exceed 1 mm; these can be difficult to measure, especially hairs on the cap of dried herbarium material which are often broken (Ronikier 2003).

Xerula pudens (the current name of the generic type *Agaricus longipes* Bull.) is widely distributed throughout Europe and in southwestern Russia;

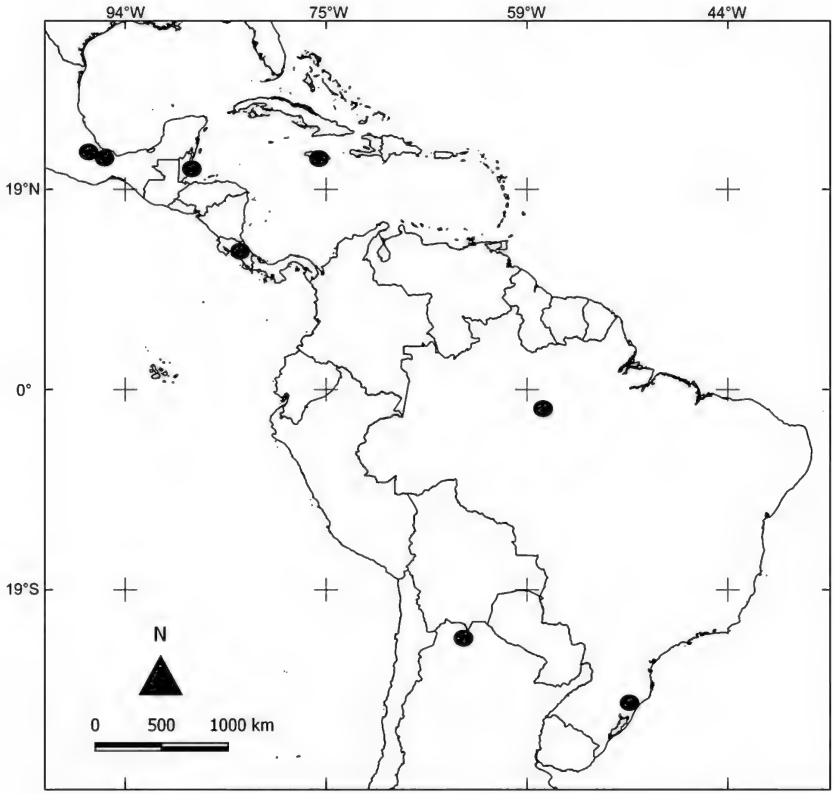

Fig. 3. Distribution of *Xerula setulosa* in America. Map adapted by N. Niveiro.

it is distinguished from *X. setulosa* by its longer basidioma with a small pileus in relation to the stipe.

Xerula sinopudens, distributed in tropical to temperate Asia, is characterized by its carrot-shaped pseudorhiza and interspersed long (0.55 mm) and short pileosetae (Petersen & Hughes 2010).

Xerula strigosa of southwest China and Southeast Asia, which is macroscopically remarkably similar to *X. setulosa*, can be distinguished with difficulty microscopically by its longer (11–5 × 9–11.5 µm) basidiospores, occasional clamp connections on the septa of basidia and lamellar hyphae, and thin-walled pleurocystidial apices (Wang & al. 2008).

As regards pileus size, our material differs from previous descriptions. The pileus is larger (35 mm) than those reported by Putzke & Pereira (1988; ≤10 mm) and Petersen & Baroni (2007; ≤20 mm), although it is close to or matches material from Paraná, Brazil (23–40 mm; Meijer 2008) and Jalisco, Mexico (20–30 mm; Rodriguez-Alcántar & Herrera-Fonseca 2016). Our Argentinean basidiospore size is similar to those in Meijer (2008) and Petersen and Baroni (2007), larger than in Singer (1954, 1964; 10 × 6.9 µm) and smaller than in Dörfelt (1985; 10–16 × 9.5–14 µm) and Wang (2008; 11–16 × 9.5–12 µm). Taking into account pileus colour and size, the spores, the pleurocystidia, and the caulocystidia size, the Argentinean specimen described here matches the descriptions by Meijer (2008) and Rodríguez-Alcántar & Herrera-Fonseca (2016).

Xerula setulosa has a Neotropical distribution (Fig. 3) and has been reported from Mexico, Belize, Jamaica, Puerto Rico (Petersen & Baroni 2007), Brazil (Putzke & Pereira 1988, Meijer 2002, 2006, 2008), and Costa Rica (Wang & al 2008). The present record represents the first report from Argentina.

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